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EXAMINER	
BLAN, NICOLE R	

ART UNIT	PAPER NUMBER
1792	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/509,955	BANERJEE ET AL.	
	Examiner	Art Unit	
	NICOLE BLAN	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 November 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-10, 12, 13 and 15-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10,12,13 and 15-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on November 7, 2008 has been entered. The amendments to claims 1 and 18 as well as the cancellation of claim 14 is acknowledged. Claims 1-10, 12, 13 and 15-20 are currently pending.

2. In view of the amendment to claim 1, the previous rejection under 35 U.S.C. 112, second paragraph is withdrawn. However, in view of this amendment, a new rejection under35 U.S.C. 112, second paragraph is applied. Please refer to the detailed discussion below.

Response to Arguments

3. Applicant's arguments filed November 7, 2008 have been fully considered but they are not persuasive.

4. In response to applicant's argument regarding Rose, the Examiner does not find this persuasive. As methanol vapor contacts the surface of the substrate, it will inherently condense and form a liquid film on the substrate before it evaporates. In the absence of unexpected results, the thickness of the layer of the liquid is a result effective variable. The surface tension of methanol reacts in such a way that when a drop of methanol contacts a surface, it quickly spreads

out into a layer. It would have been obvious to optimize the liquid thickness in order to provide maximum drying results. To an ordinary artisan, applying too much methanol would result in using more of the chemical which drives up costs as well as increases the process time and applying too little methanol results in increased contaminants from watermarks and allowing unprocessed substrates to continue onto the next phase of fabrication. Without evidence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time of the invention to determine the appropriate thickness of the solution for the predictable results of cleaning the component of a semiconductor processing system, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Rose'721 does not explicitly teach contacting the surface for either up to 10 minutes or less than 2 minutes prior to the cryogenic cleaning. The time period in which the surface is contacted for cleaning is a result effective variable. The time required for cleaning is dependent upon many factors such as the type of contaminant to be removed, the quantity/size of the contaminants to be removed as well as the size of the wafer to be cleaned. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to optimize the cleaning time, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

5. In response to applicant's argument regarding Starov in view of Rose, the Examiner does not find this persuasive. The wherein clause of the claim specifies that the fluid in (a) is either a liquid, a reactive gas or a vapor. The claim as currently amended only require the thickness of the fluid and time the fluid remains in contact with the surface when *a liquid* is applied; thus, when the fluid is a reactive gas or vapor, this limitation does not apply. Such is the case of Starov in view Rose because Starov teaches applying a reactive gas prior to the cryogenic cleaning of Rose. Furthermore, the claim does not require condensing to be present except when a liquid is utilized in step (a) because the wherein clause specifically requires a liquid being applied to the surface. Additionally, condensing from the reactive gas and the vapor is not required by the claimed limitation because it merely says condensation is provided.

The teaching of Starov and Rose occur in two step parts. First the substrate is cleaned using the method of Starov. It is notoriously well known to use multiple cleaning steps that differ in their application of solutions in order to remove certain contaminants that may be left behind and improve the overall cleanliness of the substrate. Then the substrate is cleaned using the cryogenic cleaning method of Rose. Without evidence of unexpected results it would have been obvious to perform a plasma cleaning process as taught by Starov '268 and to perform a cryogenic stream cleaning process as disclosed by '721 in order to ensure that all contaminants are removed from the surface to ensure the overall cleanliness of the substrate is improved. All of the steps are known in Starov '268 and Rose '721. The only difference is the combination of the steps in a single method. Thus, without evidence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the two known cleaning techniques of Starov '268 and Rose '721 for the predictable results of removing

contaminants from the surface of a substrate. Therefore, the cleaning steps are carried out sequentially.

Furthermore, the claim also uses the transitional phrase "comprising", which according to MPEP 2111.03, is synonymous with "including," "containing," or "characterized by," is inclusive or open-ended and does not exclude additional, unrecited elements or method steps. See Genentech, Inc. v. Chiton Corp., 112 F.3d 495,501, 42 USPQ2d 1608, 1613 (Fed. Cir. 1997). Therefore, the claim does not exclude additional method steps such as the condensate sonic treatment of the surface disclosed by Starov.

6. In response to applicant's argument regarding Verhaverbeke in view of Rose, the Examiner respectfully disagrees. Verhaverbeke teaches a process for the removal of contaminants from a surface of a substrate requiring precision cleaning, comprising applying a liquid or a vapor, such as, isopropyl alcohol. As an IPA vapor contacts the surface of the substrate, it will inherently condense and form a liquid film on the substrate before it evaporates.

In the absence of unexpected results, the thickness of the layer of the liquid is a result effective variable. The surface tension of IPA reacts in such a way that when a drop of IPA contacts a surface, it quickly spreads out into a layer. It would have been obvious to optimize the liquid thickness in order to provide maximum drying results. To an ordinary artisan, applying too much IPA would result in using more of the chemical which drives up costs as well as increases the process time and applying too little IPA results in increased contaminants from watermarks and allowing unprocessed substrates to continue onto the next phase of fabrication. Without evidence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time of the invention to determine the appropriate thickness of the solution for the

predictable results of cleaning the component of a semiconductor processing system, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Verhaverbeke does not explicitly teach contacting the surface for either up to 10 minutes or less than 2 minutes prior to the cryogenic cleaning. The time period in which the surface is contacted for cleaning is a result effective variable. The time required for cleaning is dependent upon many factors such as the type of contaminant to be removed, the quantity/size of the contaminants to be removed as well as the size of the wafer to be cleaned. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to optimize the cleaning time, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

The teaching of Verhaverbeke and Rose occur in two step parts. First the substrate is cleaned using the method of Verhaverbeke. Verhaverbeke does not teach cleaning the substrate surface with a cryogenic stream. However, it is notoriously well known to use multiple cleaning steps that differ in their application of solutions in order to remove certain contaminants that may be left behind and improve the overall cleanliness of the substrate. Rose teaches cleaning the substrate surface with a cryogenic stream. Without evidence of unexpected results it would have been obvious to perform a plasma cleaning process as taught by Verhaverbeke and to perform a cryogenic stream cleaning process as disclosed by Rose in order to ensure that all contaminants are removed from the surface to ensure the overall cleanliness of the substrate is improved. All

of the steps are known in Verhaverbeke and Rose . The only difference is the combination of the steps in a single method. Thus, without evidence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the two known cleaning techniques of Verhaverbeke and Rose for the predictable results of removing contaminants from the surface of a substrate while the cleaning steps are being carried out sequentially.

Furthermore, the claim also uses the transitional phrase "comprising", which according to MPEP 2111.03, is synonymous with "including," "containing," or "characterized by," is inclusive or open-ended and does not exclude additional, unrecited elements or method steps. See Genentech, Inc. v. Chiton Corp., 112 F.3d 495,501, 42 USPQ2d 1608, 1613 (Fed. Cir. 1997). Therefore, the claim does not exclude a gas being applied to the surface as disclosed by Verhaverbeke.

Claim Rejections - 35 USC § 112

7. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

8. Claims 1-10, 12, 13 and 15-20 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claim 1: The amendment to claim 1 is not fully supported in the original disclosure. Specifically, there is no disclosure for the phrase "*any* condensation" as well as "*any* condensation … evaporate prior to the cleaning with the cryogenic stream." The disclosure provides support for the type of cryogenic stream, the thickness of the liquid, the time the liquid remains on the surface, and evaporating without the use of heat. Regarding the phrase "*any* condensation", this indicates that only condensation occurs on the surface of the substrate and not the surrounding area such as the supply nozzle, the holder or even the chamber itself. There is no such disclosure in the specification. The step of evaporating the liquid prior to administering the cryogenic stream is also not supported because the disclosure does not state that the liquid is completely evaporated.

The wherein clause of the claim specifies that the fluid in (a) is either a liquid, a reactive gas or a vapor. The claim as currently amended only require the thickness of the fluid and time the fluid remains in contact with the surface when *a liquid* is applied; thus, when the fluid is a reactive gas or vapor, this limitation does not apply. The claim does not require condensing to be present except when a liquid is utilized in step (a) because the wherein clause specifically requires a liquid being applied to the surface. Additionally, condensing from the reactive gas and the vapor is not required by the claimed limitation because it merely says condensation is provided. The specification only discloses condensing when a vapor is used and does not support condensing of a reactive gas. The Examiner is well aware that vapor and reactive gas are addressed in the specification as the same thing, but they are addressed separately in the claims. Furthermore, the claim as currently amended raises the question of enablement, especially for gases like oxygen which require a temperature of -183°C in order to condense.

Claims 2-10, 12, 13 and 15-20 are rejected as being dependent upon a rejected claim.

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. Claims 1 and 2 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

11. Claim 2 states that steps (a) and (b) are carried out simultaneously. Claim 1 from which claim 2 depends requires that step (a) when it's a liquid being applied and any condensation from the reactive gas or vapor is removed prior to cleaning with the cryogenic stream which is step (b). If (a) is to happen prior to (b), how according to claim 2 are they to be carried out simultaneously. It is unclear what the applicant's are trying to claim. For the purpose of examination, the Examiner is interpreting this to mean that an initial amount of the liquid evaporates on initial contact.

Specification

12. The disclosure is objected to because of the following informalities: On page 12 of the specification a list of References is given that were cited throughout pages 1-11 of the specification. This is not the recommended format for the specification. Please include the titles in the disclosure instead of citing using the numbers. Appropriate correction is requested.

Claim Objections

13. Claims 8 and 9 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claims 8 and 9 contain an identical limitation that is already cited in parent claim 1 with respect to the liquid being applied to the surface.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

15. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

16. Claims 1, 2, 5, 7 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rose et al. (U.S. Patent 5,931,721, hereafter Rose '721).

Claims 1-2, 4-7, 12-13, and 15: Rose '721 teaches a process for the removal of contaminants from a surface of a substrate [col. 3, lines 29-33; col. 7, lines 20-32] comprising a)

applying at least one fluid to the substrate surface, the fluid selected from the group consisting of: a liquid, such as, methanol [col. 2, lines 62-67; col. 3, lines 1-2 and 29-33; col. 10, lines 18-58; col. 14, lines 26-38] which inherently has a vapor pressure greater than about 5 kPa at 25°C, a freezing point below about -50°C, a dipole moment greater than 1.5 D, and is considered to be a drying agent [col. 2, lines 62-67; col. 3, lines 1-2]; a reactive gas, such as, ozone [col. 14, lines 26-33]; or a vapor of a reactive liquid, such as methanol; and b) cleaning the substrate surface with a cryogenic stream simultaneously [col. 7, lines col. 10, lines 18-58].

As methanol vapor contacts the surface of the substrate, it will inherently condense and form a liquid film on the substrate before it evaporates. In the absence of unexpected results, the thickness of the layer of the liquid is a result effective variable. The surface tension of methanol reacts in such a way that when a drop of methanol contacts a surface, it quickly spreads out into a layer. It would have been obvious to optimize the liquid thickness in order to provide maximum drying results. To an ordinary artisan, applying too much methanol would result in using more of the chemical which drives up costs as well as increases the process time and applying too little methanol results in increased contaminants from watermarks and allowing unprocessed substrates to continue onto the next phase of fabrication. Without evidence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time of the invention to determine the appropriate thickness of the solution for the predictable results of cleaning the component of a semiconductor processing system, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Rose'721 does not explicitly teach contacting the surface for either up to 10 minutes or less than 2 minutes prior to the cryogenic cleaning. The time period in which the surface is contacted for cleaning is a result effective variable. The time required for cleaning is dependent upon many factors such as the type of contaminant to be removed, the quantity/size of the contaminants to be removed as well as the size of the wafer to be cleaned. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to optimize the cleaning time, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Claim 8-9: Rose '721 teaches the limitations of claim 1 above. It does not explicitly teach contacting the surface for either up to 10 minutes or less than 2 minutes prior to the cryogenic cleaning. The time period in which the surface is contacted for cleaning is a result effective variable. The time required for cleaning is dependent upon many factors such as the type of contaminant to be removed, the quantity/size of the contaminants to be removed as well as the size of the wafer to be cleaned. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to optimize the cleaning time, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Claim 16: The process of claim 1 wherein the substrate surface is a semiconductor, metal or dielectric film [col. 1, lines 1-7].

17. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rose '721 as applied to claim 1 above, and further in view of Kuyel (U.S. PGPub 2003/0010356, hereafter Kuyel '356).

Claim 10: Rose '721 teaches the limitations of claim 1 above. It does not explicitly teach the size of the contaminants. However, Kuyel '356 teaches that it is conventional to clean a substrate [i.e. workpiece] to remove particulates and residues down to 0.05 micrometers. It would have been obvious to one of ordinary skill in the art at the time the invention was made to clean a substrate with particles less than 0.76 and 0.13 micrometers if it is conventional to remove all residues greater than 0.05 micrometers.

18. Claims 1, 3, 6-9 and 16-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Starov et al. (U.S. Patent 6,333,268, hereafter Starov '268), and in view of Rose '721.

Claims 1 and 3: Starov '268 teaches a process for the removal of contaminants from a surface of a substrate requiring precision cleaning, comprising applying a reactive gas of the type which reacts with contaminants [col. 3, lines 11-15; col. 6, lines 37-67; col. 7, lines 1-41]. Starov '268 does not teach cleaning the substrate surface with a cryogenic stream. However, it is notoriously well known to use multiple cleaning steps that differ in their application of solutions in order to remove certain contaminants that may be left behind and improve the overall cleanliness of the substrate. Rose '721 teaches cleaning the substrate surface with a cryogenic

stream [col. 7, lines col. 10, lines 18-58]. Without evidence of unexpected results it would have been obvious to perform a plasma cleaning process as taught by Starov '268 and to perform a cryogenic stream cleaning process as disclosed by '721 in order to ensure that all contaminants are removed from the surface to ensure the overall cleanliness of the substrate is improved. All of the steps are known in Starov '268 and Rose '721. The only difference is the combination of the steps in a single method. Thus, without evidence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the two known cleaning techniques of Starov '268 and Rose '721 for the predictable results of removing contaminants from the surface of a substrate. Therefore, the cleaning steps are carried out sequentially [reads on claim 3].

Regarding the limitation, "wherein the liquid is applied for remaining on the substrate surface in a layer ... and preferably less than 2 minutes to evaporate" is not required because Starov '268 teaches using a reactive gas. Furthermore, in view of the rejection under 35 U.S.C. 112, first paragraph discussed above, the art addressed above meets the claimed limitations because Starov '268 uses a mixture of NF_3 and O_2 as the reactive gas and in order to condense oxygen it must be at -183°C.

Claims 6-7: Starov '268 and Rose '721 teach the limitations of claim 1 above. Starov '268 also teaches using a mixture of NF_3 and O_2 as the reactive gas [col. 7, lines 24-25].

Claim 8-9: Starov '268 and Rose '721 teach the limitations of claim 1 above. They do not explicitly teach contacting the surface for either up to 10 minutes or less than 2 minutes prior

to the cryogenic cleaning. The time period in which the surface is contacted for cleaning is a result effective variable as disclosed by Starov '268 [col. 26, lines 61-67; col. 27, lines 1-10]. The time required for cleaning is dependent upon many factors such as the type of contaminant to be removed, the quantity/size of the contaminants to be removed as well as the size of the wafer to be cleaned. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to optimize the cleaning time, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Claim 16: Starov '268 and Rose '721 teach the limitations of claim 1 above. Both Starov '268 and Rose '721 teach that the substrate surface is a semiconductor [col. 1, lines 10-15 in Starov '268 and col. 1, lines 5-10 in Rose '721].

Claim 17: Starov '268 and Rose '721 teach the limitations of claim 1 above. Starov '268 teaches that at least one fluid is a reactive, as described above in claim 1, is in contact with a surface of a substrate for a predetermined time [see explanation in claims 8-9 above], and removing the gaseous byproduct [via a purge stream; col. 27, lines 10-13] prior to the dense fluid treatment step [i.e. cryogenic cleaning; see discussion of claim 1 above].

Claim 18: Starov '268 and Rose '721 teach the limitations of claim 17 above. Starov '268 also teaches that the reactive gas is introduced into the process at a temperature of about 30°C [col. 7, lines 32-33].

Claim 19: Starov '268 and Rose '721 teach the limitations of claim 18 above. Starov '268 also teaches purging the chamber with nitrogen [col. 27, lines 10-13].

Claim 20: Starov '268 and Rose '721 teach the limitations of claim 17 above. Starov '268 also teaches that the reactive gas is applied in the presence of a free radical initiator, plasma [col. 7, lines 10-25]. It is noted that strictly speaking plasma is not usually regarded as a free radical initiator, but is used as the reactive specie.

19. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Starov; 268 and Rose '721 as applied to claim 1 above, and further in view of Kuyel '356.

Claim 10: Starov '268 and Rose '721 teach the limitations of claim 1 above. They do not explicitly teach the size of the contaminants. However, Kuyel '356 teaches that it is conventional to clean a substrate [i.e. workpiece] to remove particulates and residues down to 0.05 micrometers. It would have been obvious to one of ordinary skill in the art at the time the invention was made to clean a substrate with particles less than 0.76 and 0.13 micrometers if it is conventional to remove all residues greater than 0.05 micrometers.

20. Claims 1, 3-4, 8-9, and 12-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Verhaverbeke et al. (U.S. PGPub 2002/0062840, hereinafter Verhaverbeke '840), and in view of Rose '721.

Claims 1, 3-5, 7, 12-13 and 15: Verhaverbeke '840 teaches a process for the removal of contaminants from a surface of a substrate requiring precision cleaning, comprising applying a liquid or a vapor, such as, isopropyl alcohol [abstract; page 1, paragraphs 6 and 14-15; page 3, paragraph 26] which inherently has a vapor pressure greater than about 5 kPa at 25°C, a freezing point below about -50°C, a dipole moment greater than 1.5 D, and is considered to be a drying agent. As an IPA vapor contacts the surface of the substrate, it will inherently condense and form a liquid film on the substrate before it evaporates.

In the absence of unexpected results, the thickness of the layer of the liquid is a result effective variable. The surface tension of IPA reacts in such a way that when a drop of IPA contacts a surface, it quickly spreads out into a layer. It would have been obvious to optimize the liquid thickness in order to provide maximum drying results. To an ordinary artisan, applying too much IPA would result in using more of the chemical which drives up costs as well as increases the process time and applying too little IPA results in increased contaminants from watermarks and allowing unprocessed substrates to continue onto the next phase of fabrication. Without evidence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time of the invention to determine the appropriate thickness of the solution for the predictable results of cleaning the component of a semiconductor processing system, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering

the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Verhaverbeke '840 does not explicitly teach contacting the surface for either up to 10 minutes or less than 2 minutes prior to the cryogenic cleaning. The time period in which the surface is contacted for cleaning is a result effective variable. The time required for cleaning is dependent upon many factors such as the type of contaminant to be removed, the quantity/size of the contaminants to be removed as well as the size of the wafer to be cleaned. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to optimize the cleaning time, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Verhaverbeke '840 does not teach cleaning the substrate surface with a cryogenic stream. However, it is notoriously well known to use multiple cleaning steps that differ in their application of solutions in order to remove certain contaminants that may be left behind and improve the overall cleanliness of the substrate. Rose '721 teaches cleaning the substrate surface with a cryogenic stream [col. 7, lines col. 10, lines 18-58]. Without evidence of unexpected results it would have been obvious to perform a plasma cleaning process as taught by Verhaverbeke '840 and to perform a cryogenic stream cleaning process as disclosed by Rose '721 in order to ensure that all contaminants are removed from the surface to ensure the overall cleanliness of the substrate is improved. All of the steps are known in Verhaverbeke '840 and Rose '721. The only difference is the combination of the steps in a single method. Thus, without evidence of unexpected results, it would have been obvious to one of ordinary skill in the art at

the time of the invention to combine the two known cleaning techniques of Verhaverbeke '840 and Rose '721 for the predictable results of removing contaminants from the surface of a substrate while the cleaning steps are being carried out sequentially [reads on claim 3].

Claim 8-9: Verhaverbeke '840 and Rose '721 teach the limitations of claim 1 above. They do not explicitly teach contacting the surface for either up to 10 minutes or less than 2 minutes prior to the cryogenic cleaning. The time period in which the surface is contacted for cleaning is a result effective variable. The time required for cleaning is dependent upon many factors such as the type of contaminant to be removed, the quantity/size of the contaminants to be removed as well as the size of the wafer to be cleaned. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to optimize the cleaning time, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

21. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Verhaverbeke '840 and Rose '721 as applied to claim 1 above, and further in view of Kuyel '356.

Claim 10: Verhaverbeke '840 and Rose '721 teach the limitations of claim 1 above. They do not explicitly teach the size of the contaminants. However, Kuyel '356 teaches that it is conventional to clean a substrate [i.e. workpiece] to remove particulates and residues down to 0.05 micrometers. It would have been obvious to one of ordinary skill in the art at the time the

invention was made to clean a substrate with particles less than 0.76 and 0.13 micrometers if it is conventional to remove all residues greater than 0.05 micrometers.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to NICOLE BLAN whose telephone number is (571)270-1838. The examiner can normally be reached on Monday - Thursday 8-5 and alternating Fridays 8-4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Cleveland can be reached on 571-272-1418. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/N. B./
Examiner, Art Unit 1792

/Alexander Markoff/
Primary Examiner, Art Unit 1792